A comparison of different methods for image deblurring

Joab Winkler, Department of Computer Science
The University of Sheffield, Sheffield, United Kingdom
j.r.winkler@sheffield.ac.uk

The removal of blur from an image is one of the most important operations in image processing and it may be considered a preprocessing operation in all applications because image interrogation is significantly easier if the image is of high quality. The removal of blur is called image deconvolution because the point spread function (PSF), which represents the blur, is deconvolved from the blurred image in order to compute the restored image. The greatest research effort is devoted to the problem of *blind image deconvolution*, that is, the restored image must be computed in the absence of prior knowledge of the PSF and the exact image. Many different methods for its solution have been developed, of which methods based on Bayes' theorem and resultant matrices are the most popular.

These methods will be reviewed, and in particular, their fundamentally different features will be considered. The methods for the solution of the problem of blind image deconvolution that use Bayes' theorem require prior information, which is imposed in the form of probability distributions on the PSF and the exact image. By contrast, priors are not required when resultant matrices are used, and the deblurred image is obtained by polynomial computations, specifically, greatest common divisor computations and polynomial deconvolutions.

The talk will compare the deblurred images obtained from these two methods, and it will be shown that the methods based on Bayes' theorem solve the problem of semi-blind image deconvolution because they require that the size of the PSF be specified. By contrast, this information is calculated in the method that uses resultant matrices, and it is not, therefore, specified, It will be shown that resultant matrices have strong structure, which is imposed on the computations by using structure-preserving matrix methods, and these methods explain the very good results obtained by resultant matrices. Also, some theoretical properties of these matrices will be considered and it will be shown that the QR decomposition of the Sylvester resultant matrix, which is one type of resultant matrix, allows the size of the PSF to be computed.